FIVE UNDESCRIBED SPECIES OF RAVENELIA

W. H. Long

The five species described in this article were collected during 1914 and 1915. Three of them are from Texas, one is from Florida, and one from Arizona.

There are known now to occur in Texas 11 species of *Ravenelia*, including 3 of the new species described in this paper, namely, (1) *Ravenelia arizonica* Ellis and Ev. on *Prosopis juliflora*, (2) *R. versatilis* (Peck) Dietel on *Acacia greggii*, (3) *R. igualica* Arthur on *Acacia filiculoides*, (4) *R. texensis* Ellis and Gall. on *Acuan jamesii* and *A. acuminata*, (5) *R. fragrans* Long on *Mimosa fragrans*, (6) *R. cassiaecola* Atk. on *Chamaecrista multipinnata* (?), (7) *R. longiana* Syd. on *Cassia roemeriana*, (8) *R. papillifera* Syd. on *Cassia lindheimeriana*, and the 3 species here described: (9) *R. roemerianae* on *Acacia roemeriana*, (10) *R. morongiae* on *Morongia uncinata*, and (11) *R. thornberiana* on *Acacia constricta paucispina*. The types of 7 of these species (*R. texensis*, *R. roemerianae*, *R. thornberiana*, *R. fragrans*, *R. longiana*, *R. papillifera*, and *R. morongiae*) were collected in Texas, while the type locality of the last 4 named is Austin, Texas.

Many Mexican species of this genus undoubtedly will be found in southwestern Texas, especially in the territory lying between El Paso and Brownsville along the Rio Grande. *R. cassiaecola* is reported for the first time west of the Mississippi River, the writer having collected it at Denton, Texas.

Two closely related genera, *Neoravenelia* and *Pleoravenelia*, are also represented in this state, the former by *N. Holwayi* (Dietel) Long on *Prosopis juliflora*, and the latter by *P. Hieronymi* (Speg.) Long on *Vachellia farnesiana*. *P. epiphylla* (Schw.) Long should be found also in the northeastern part of the state, since the writer has recently collected this species in southern Arkansas near the Texas border.

Ravenelia roemerianae, sp. nov.

O. Pycnia unknown.

II. Urediniospores intermixed with the teliospores, oval, obovate to obovate-oblong, 13–18×28–37 μ, average for 10 spores 15.4×32.2 μ; walls thin, 1–1.5 μ, slightly thicker above, prominently but sparsely echinulate; spinules very sparse to almost wanting on upper third of spore, upper half golden brown to wine color, lower half paler or almost colorless; germ pores 8, equidistant in two zones of 4 each, one zone in equator, the other between equator and base of spore; paraphyses abundant, intermixed with the spores, clavate to clavate-capitate, 35–50 μ long, average length for 10 paraphyses 44.4 μ, heads 8–13 μ broad, average for 10 heads 10 μ, apex of head thickened about 3 μ, pale fulvous, stipe solid to thin-walled, semi-hyaline.

III. Telia epiphyllous, rarely hypophyllous, scattered, soon naked; subcuticular, blackish, shining, 0.3–1 mm. across, irregularly oval, ruptured cuticle moderately noticeable; teliospore heads chestnut brown, 5–7 cells across, 67–86 μ, average for 10 spores 75.2 μ, verrucose, each spore bearing 6–10 colorless warts about 2 μ high by 3 μ broad; cysts 6–8, flattened and appressed beneath the head, extending from periphery to pedicel, ovoid to oblong-ovate, slow to burst in water, united laterally; pedicel short, colorless, deciduous.

On Mimosaceae. Type collected on *Acacia roemeriana* at San Marcos, Texas, November 1, 1915, by *W. H. Long* (no. 5498). This rust is probably distributed throughout southwestern Texas within the range of its host, but at present is known only from the type locality.

Ravenelia roemerianae is closely related to *R. versatilis*, but differs in its smaller and verrucose teliospore heads and in the fact that it does not form witches' brooms as does *R. versatilis*. Only a few urediniospores of *R. roemerianae* were seen. The urediniospores of both species are very similar in size, shape, color, and in the number and arrangement of the germ pores. These are the only two species of *Ravenelia* so far known which have two rows of germ pores, one in the equator and the other near the base of the spore.

Ravenelia morongiae, sp. nov.

O. Pycnia unknown.

II. Uredinia amphigenous and caulicolous, perennial in tissues of host, often causing early shoots to become swollen and some-

what abortive, but not forming distinct witches' brooms, thickly covering large areas, sometimes confluent or scattered or in circinating groups, oval to irregularly orbicular on leaves, or oblong and often confluent on the branches, subcuticular, early naked, light cinnamon brown, pulverulent, ruptured cuticle inconspicuous; paraphyses very numerous, intermixed with the spores or in separate sori, very variable in shape and size, ranging from clavate to subcapitate or even bladdery, 40–60×12–20 μ, usual length 50 μ, head and stipe about equal in length, heads 12–20×20–25 μ, walls of head very thin, about 1 μ thick, except at apex where the walls are about 3 μ thick, apex pale fulvous to cinnamon brown, strongly colored for 5–7 μ as if thickened, remainder of head semi-hyaline, stipe hyaline, sometimes solid, 2–4 μ thick, 22–30 μ long, many of the paraphyses collapse to a hypha-like shape; urediniospores broadly oval to globose, 14–18×15–20 μ, average for 10 spores 16.5×17.6 μ; walls 1.5–2 μ, fulvous, densely verrucose-spinulose, concolorous, germ pores 8–12, scattered.

III. Telia hypophyllous, small, scattered, sparse, very inconspicuous, irregularly oval, blackish, shining, pulverulent, subcuticular, soon naked, ruptured cuticle inconspicuous; teliospore heads chestnut brown, strongly convex above, 4–6 cells across, 6–12 peripheral cells, 50–70 μ, average for 10 heads 61.7 μ, smooth; cysts few, about as many as peripheral spores of head, closely appressed to under side of head around the stipe, slowly swelling in water to a globular shape and bursting; pedicel very short, hyaline, deciduous.

On Mimosaceae. Type for uredinia collected on *Morongia uncinata* at Austin, Texas, May 23, 1915, by *W. H. Long* (no. 5398). Type for telia collected in same locality and on same host October 29, 1915 (no. 5474, *W. H. Long*).

Although this host is very common and widely distributed, ranging from Virginia to Florida along the Atlantic coast and from South Dakota through Arkansas and Texas to the Gulf of Mexico, this is the first time a species of *Ravenelia* has been reported on it. For 15 years the writer has carefully examined any plants of *Morongia* seen on every field trip, but never with any success until this past year. The rust was found in one of the cemeteries at Austin and was limited to an area about 20 feet in diameter, although the host was widely distributed in that immediate vicinity.

An abundance of uredinia was present on the host in May, but no telia were found. A second collection from the same spot in July by Dr. I. M.

LEWIS still showed only uredinia. In October Dr. LEWIS and the writer again visited the same area and found telia sparingly present. Only an occasional leaf on each plant showed any telia, and then usually only one or two sori to a leaflet. The rust is very inconspicuous, even when the host is thoroughly infected with the uredinial stage, and it is almost impossible to find in the telial stage.

Ravenelia thornberiana, sp. nov.

O. Pycnia unknown.

II. Uredinia amphigenous, caulicolous and fruticolous, usually forming small witches' brooms 3–6 cm. long by 2–4 cm. broad, consisting of a rather dense interwoven mass of abortive branches, petioles, and young pods, thickly covering large areas, often confluent on stems and pods, irregularly orbicular to elliptical or on the branches oblong, very small, 0.2–0.5 mm. in diameter, subcuticular early naked, cinnamon brown, ruptured cuticle noticeable; paraphyses abundant, intermixed with the urediniospores, clavate to subcapitate, 10–13×35–57 μ, heads 10–13×13–17 μ, average for 10 heads 11.6×15.8 μ, apex of head fulvous, lower one-third semi-hyaline, walls 2–3 μ thick, rarely slightly thicker at apex, stipe attenuate, hyaline, 2–4 μ thick by 20–40 μ long, average for 10 stipes 3×31.4 μ; urediniospores obovate, pyriform or oval, 16–18 ×20–27 μ, average for 10 spores 17×23.5 μ, walls 1.5–2 μ thick, sometimes slightly thicker at base, densely and evenly verrucose, cinnamon brown, concolorous, pores 8–12, in two transverse zones of 4–6 pores each, equidistant from the equator.

III. Telia amphigenous and caulicolous, small, 0.2–0.5 mm. in diameter, irregularly oval, scattered, or often confluent on the petioles and stems, subcuticular, chestnut brown, ruptured cuticle noticeable; teliospore heads chestnut brown, 70–90 μ in diameter, average for 10 heads 80 μ, 4 or 5 spores across, 8–14 marginal spores, smooth; paraphyses present, stipe often not attenuate and solid, otherwise as in the uredinia; cysts delicate, numerous beneath entire head, in two irregular rows around stipe, subappressed, easily swelling and bursting in water, becoming pendent and subglobose in water; pedicel short, hyaline, deciduous.

On Mimosaceae. Type for uredinia collected on *Acacia constricta paucispina* at El Paso, Texas, August 7, 1915, by *W. H. Long* (no. 5505). Type for telia collected in same locality and on same host December 20, 1915 (no.

5506, *W. H. Long*); also collected at Tucson, Arizona, on *Acacia constricta paucispina* (nos. 5507 and 5508, *W. H. Long*).

On a recent trip to Tucson, the writer's attention was called by Professor THORNBER, of the University of Arizona, to a species of *Ravenelia* on *Acacia constricta paucispina* which formed small witches' brooms. The host was growing on the grounds of the University of Arizona immediately adjacent to a tree of *Acacia greggii* which has heavily infected with *R. versatilis*. The close proximity of the two host trees and the fact that both bore witches' brooms suggested the possibility of the *Ravenelia* on *Acacia constricta paucispina* being *R. versatilis*. However, a microscopic examination of the rust revealed marked differences in the urediniospores which easily separated it from *R. versatilis*. On this trip, the writer revisited a locality at El Paso, Texas, where he had collected a *Ravenelia* in August 1915 on an unidentified host. This host proved to be *Acacia constricta paucispina*, and the *Ravenelia* on it was identical in every way with that collected on the same host at Tucson, Arizona. The specimens of *R. thornberiana* collected at Tucson had only fresh telia intermixed with old and weathered uredinia. The collection of this rust made by the writer at El Paso in August 1915 consisted of fine uredinial material, while that made from the same trees at El Paso in December 1915 was good telial material. For this reason, the material collected at El Paso is made the type for the species.

The number of species of *Ravenelia* previously described whose uredinia or telia cause pronounced witches' brooms is limited to 4 species, namely, *R. versatilis* on *Acacia greggii*, *R. fragrans* on *Mimosa fragrans*, both American species; and two African species, *R. volkensii* P. Henn. on *Acacia* sp. (only the teliospores of which are known), and *R. natalensis* Syd. and Evans on *Acacia hirtella* (which has aecia as well as uredinia and telia). Of these 4 species, *R. versatilis* is the only one which has urediniospores with two rows of germ pores, but this species has one row at the equator and the other near the base of the spore, while *R. thornberiana* has its two rows of germ pores equidistant from the equator. The lower halves of the urediniospores of *R. versatilis* are hyaline, while the urediniospores of *R. thornberiana* have walls uniformly colored.

There are only two described species of *Ravenelia* with germ pores in two rows equidistant from the equator, namely, *R. siliquae* Long on *Vachellia farnesiana* and *R. acaciae-pennatulae* Dietel on *Acacia pennatula*. *R. thornberiana* differs from *R. siliquae* in having very small uredinia and in the shape and size of its urediniospores. It differs from *R. acaciae-pennatulae* in having smooth teliospore heads.

Ravenelia reticulatae, sp. nov.

O. Pycnia unknown.

II. Uredinia hypophyllous, scattered, punctiform to elliptical, very small, 0.25–0.5 mm. across, subcuticular, tardily naked,

light cinnamon brown in herbarium material, ruptured cuticle noticeable; paraphyses present but not abundant, intermixed with the urediniospores, clavate to spoon-shaped, 10–13×40–70 μ, average for 10 paraphyses 12×47 μ, wall thickened above, 5–8 μ, heads fulvous, stipe hyaline, solid; urediniospores globoid, 16×16–19 μ, average for 10 spores 16×16.9 μ; walls pale fulvous, 1–1.5 μ thick, concolorous, densely verruculose, pores 6–10, scattered.

III. Telia amphigenous, scattered, large compared to uredinia, oval to orbicular, 0.5–1.5 mm. across, subcuticular, early naked, ruptured cuticle noticeable, chestnut brown; paraphyses few; teliospore heads light chestnut brown, 65–105 μ in diameter, average for 10 heads 82.4 μ, 7–9 cells across, 15–24 peripheral cells, each spore 14–16 μ across, smooth; cysts appressed to underside of head around the stipe, about one to each peripheral teliospore, swelling rather slowly and bursting in water, apparently not coherent with each other, not continuous with stipe; stipe short, hyaline, deciduous.

On Mimosaceae. Type collected on *Calliandra reticulata* at Divide, Lower Trail, Rincon Mountains, Arizona, September 12, 1909, by *J. C. Blumer*, at an altitude of 7,200 feet (no. 5510, *W. H. Long*). This species of *Ravenelia* was found by the writer in the herbarium of the University of Arizona on "*Calliandra reticulata*, plants of the Rincon Mountains, Arizona, no. 3341, *J. C. Blumer* collection."

Including the species above described, there are now 7 species of *Ravenelia* known to occur on *Calliandra*. Five of these occur in South America, namely, (1) *R. lagerheimiana* Dietel on *Calliandra* sp., (2) *R. echinata* Lagh. and Dietel on *Calliandra* sp., (3) *R. pazschkeana* Dietel on *Calliandra* sp., (4) *R. dieteliana* P. Henn. on *Calliandra microcephala*, and (5) *R. affinis* Syd. on *Calliandra turbinata*. One species, *Ravenelia mexicana* Tranz on *Calliandra grandiflora*, is found in Mexico; while the species described here, *R. reticulatae* on *Calliandra reticulata*, is the only one known from the United States on this host genus.

Ravenelia dieteliana and *R. affinis* are the only species previously described on *Calliandra* which have smooth teliospore heads. Both of these species are subepidermal and have urediniospores with germ pores (4) situated in the equator of the spores, while *R. reticulatae* is subcuticular and has 6–10 germ pores which are scattered. *R. reticulatae* also has other material differences which separate it from either of the two species having smooth teliospore heads.

R. reticulatae is closely related to *R. texensis* on *Acuan jamesii*, but differs from this species in having an entirely different host and in having smaller and thinner-walled urediniospores, while practically all of its telial characters are different.

Ravenelia annulata, sp. nov.

O. Pycnia unknown.

II. Uredinia epiphyllous, very sparingly present, elliptic to irregularly oval, small, less than 0.5 mm. in diameter, subepidermal, tardily naked, ruptured, epidermis very noticeable; paraphyses sparingly present, clavate to subcylindrical, 8–16×36–70 μ, apex thickened 5–7 μ, light chestnut brown, stipe subhyaline, walls rather thick; urediniospores ovate to ovate-fusiform, asymmetrical, usually prominently acuminate, 17–23×27–37 μ, average for 20 spores 19.5×31.4 μ; walls 2 μ thick, cinnamon brown, sparsely but prominently echinulate, with a broad hyaline band or ring around the equator 7–10 μ wide, often abruptly narrowed into a short subcylindrical base, which is hyaline for 4–7 μ, occasionally with remnants of pedicel attached, the walls of which are hyaline and minutely verruculose; germ pores 6, small, in hyaline equatorial belt.

III. Telia epiphyllous, not seated on pallid spots, small, narrowly elliptical to irregularly oval, 0.125–0.5×0.5–1.0 μ, subepidermal, light chestnut brown, tardily naked, ruptured epidermis very conspicuous; paraphyses numerous, inconspicuous, surrounding the telia, same in shape, size, and coloring as those found in the uredinia, apparently no paraphyses situated among the teliospores; teliospore heads light chestnut brown, very irregular in size and shape, irregularly oval, flattened, smooth, 50–73×53–87 μ, average for 10 heads 62.0×72 μ, 4–7 cells across, 8–16 cells around margin of head, 12–34 spores or cells in each head; cysts hyaline, few, about one to each peripheral spore, appressed, extending from pedicel to periphery, united laterally, easily bursting in water; pedicel colorless, short, deciduous.

On Mimosaceae. Type collected on *Lysiloma latisiliqua* at Miami, Florida, March 12, 1914, by *W. H. Long* (no. 4623).

This *Ravenelia* is rather common on small bushes (4–10 feet high) of this host, especially along the railroad tracks traversing the hammocks near Miami.

The strongly acuminate urediniospores with their broad, hyaline, equatorial zones and cylindrical hyaline bases make *R. annulata* a very unique species. It is closely related to *R. lysilomae*, but differs from this species in its smaller and differently-shaped sori, in its acuminate urediniospores with

hyaline cylindrical bases and 6 germ pores, and in its smaller and very irregularly-shaped teliospore heads with only about one-half as many spores to each head as *R. lysilomae*.

The writer has carefully examined mounts made from the type collection of *R. lysilomae*, and found some 30–40 urediniospores intermixed with the teliospores. None of the urediniospores seen was acuminate, all had only 4 germ pores which were rather large and prominent. The teliospore heads measured 60–100×65–120 μ in diameter, average for 10 heads 86×92 μ, 7–10 cells across, 12–20 peripheral cells and 26–50 cells to a head.

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